

CLAIMS

1. A method comprising:
identifying an abrupt transition in average light intensity between two frames; and
determining whether the abrupt transition was caused by a shot boundary between the two frames or by a flashlight event.

2. A method according to claim 1, wherein identifying an abrupt transition comprises:

calculating a difference in light intensity histograms between the current frame and a preceding frame; and

comparing the histogram difference to a dynamically determined threshold, wherein an abrupt transition is indicated if the histogram difference exceeds the threshold.

3. A method according to claim 2, wherein dynamically determining the threshold comprises:

calculating an average and standard deviation value of the histogram difference in a sliding window of frames;

generating one or more thresholds as multiples of the calculated average; and

determining whether the calculated standard deviation falls below a standard deviation threshold before adopting the generated one or more thresholds.

1 4. A method according to claim 3, wherein generating one or more
2 thresholds comprises:

3 calculating a high threshold that is four- to five-times the calculated
4 average; and

5 calculating a low average that is two- to three-times the calculated average.
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7 5. A method according to claim 4, wherein the high threshold is used to
8 determine whether an abrupt transition has occurred.
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10 6. A method according to claim 4, wherein the low threshold is used to
11 indicate whether a gradual transition has occurred, if the histogram difference does
12 not exceed the high threshold.
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14 7. A method according to claim 6, further comprising:
15 comparing the histogram difference to the low threshold;
16 accumulating the histogram difference of two or more frames if the
17 histogram difference exceeds the low threshold; and
18 determining that a gradual transition has occurred if the accumulated
19 histogram difference exceeds the high threshold.
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1 **8.** A method according to claim 1, wherein determining a cause of the
2 abrupt transition comprises:

3 calculating a difference in average minimal intensity values between a
4 window of frames preceding the current frame and a window of frames subsequent
5 to the current frame;

6 generating a ratio of the average intensity change of the current frame to the
7 calculated difference in average minimal intensity values; and

8 concluding that the abrupt transition is caused by a flashlight event if the
9 ratio does not exceed a threshold.
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11 **9.** A method according to claim 8, wherein calculating a difference in
12 average minimal intensity values comprises:

13 identifying a window of frames on either side of the current frame;

14 generating an average minimal intensity value for each window from a first
15 and second minimal intensity value of each frame, respectively; and

16 calculating the difference between the generated average minimal intensity
17 values.
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19 **10.** A method according to claim 8, wherein the threshold is equal to one
20 (1), wherein a ratio that deviates from one indicates that the abrupt transition is due
21 to a shot cut, while a ratio close to one indicates that the abrupt transition is due to
22 a flashlight event.
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1 **11.** A storage medium comprising a plurality of executable instructions
2 which, when executed, implement a method according to claim 1.
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4 **12.** A media analysis agent comprising:
5 a shot boundary detector to statistically analyze one or more attributes
6 associated with content in video frames to detect abrupt and gradual transitions in
7 the video content indicative of a shot boundary; and
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9 a flashlight detector, responsive to the shot boundary detector, to distinguish
10 abrupt transitions in the video content caused by flashlight events from those
11 caused by actual shot boundaries, to reduce false-positive identification of
12 flashlight events as shot boundaries.
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14 **13.** A media analysis agent according to claim 12, further comprising:
15 an adaptive threshold selection module, responsive to the shot boundary
16 detector, to dynamically set one or more thresholds for use in shot boundary
17 identification based, at least in part, on one or more attributes of video content.
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19 **14.** A media analysis agent according to claim 13, wherein the adaptive
20 threshold selection module calculates an average and standard deviation of a
21 histogram difference in a sliding window of frames surrounding the current frame,
22 and generates a proposed low threshold value (T_s) and a proposed high-threshold
23 value (T_b) from the average histogram difference.
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1 **15.** A media analysis agent according to claim 14, wherein the proposed
2 low threshold is two- to three-times the calculated average histogram difference,
3 while the proposed high threshold is four- to five-times the calculated average
4 histogram difference.

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6 **16.** A media analysis agent according to claim 14, wherein the adaptive
7 threshold selection module certifies the proposed thresholds if the calculated
8 standard deviation does not reach a standard deviation threshold.

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10 **17.** A media analysis agent according to claim 16, wherein if the
11 adaptive threshold selection module cannot certify the proposed thresholds, prior
12 thresholds are used by shot boundary detector.

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14 **18.** A media analysis agent according to claim 14, wherein the high
15 threshold is used to identify an abrupt transition, while the low threshold is used to
16 indicate a potential gradual transition.

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18 **19.** A media analysis agent according to claim 18, wherein shot
19 boundary detector compares the histogram difference to a low threshold if the
20 difference does not exceed the high threshold, and accumulates the histogram
21 differences of frames wherein the difference exceeds the low threshold.
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1 **20.** A media analysis agent according to claim 19, wherein shot
2 boundary detector identifies a gradual transition when the accumulated histogram
3 differences exceed the high threshold.
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5 **21.** A media analysis agent according to claim 13, wherein the shot
6 boundary detector calculates a difference in light intensity histograms between a
7 current frame and a preceding frame, and compares the histogram difference to a
8 dynamically determined threshold, wherein an abrupt transition is identified by a
9 histogram difference that exceeds the threshold.
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11 **22.** A media analysis agent according to claim 21, wherein shot
12 boundary detector invokes an instance of flashlight detector to determine whether
13 the abrupt transition is the result of a flashlight event.
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15 **23.** A media analysis agent according to claim 12, wherein flashlight
16 detector calculates a difference in average minimal intensity values between a first
17 sliding window preceding the current frame, and a second sliding window
18 subsequent to the current frame.
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20 **24.** A media analysis agent according to claim 23, wherein flashlight
21 detector calculates the average intensity change of the current frame, and generates
22 a ratio of the difference in average minimal intensity values to the average
23 intensity change of the current frame.
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1 **25.** A media analysis agent according to claim 24, wherein flashlight
2 detector determines that the abrupt change was due to a flashlight event if the ratio
3 does not exceed a threshold value.
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5 **26.** A media analysis agent according to claim 25, wherein the threshold
6 value is one (1).
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8 **27.** A media analysis agent according to claim 25, wherein the flashlight
9 detector concludes that the abrupt transition was caused by a shot boundary if the
10 ratio exceeds the threshold value.
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12 **28.** A computing system comprising:
13 a memory, to receive media content; and
14 a media processing system, coupled to the memory device, including a
15 media analysis agent according to claim 12 to segment the received media content
16 into uniquely identifiable shots.
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18 **29.** A storage medium comprising a plurality of executable instructions
19 which, when executed, implement a media analysis agent to detect shot boundaries
20 resulting from an abrupt or gradual transition in content between frames, and
21 further to distinguish abrupt transitions caused by shot cuts from those caused by
22 flashlight events.
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1 **30.** A storage medium according to claim 29, wherein the media analysis
2 agent calculates a difference in average minimal intensity values between a first
3 sliding window preceding the current frame, and a second sliding window
4 subsequent to the current frame, and calculates the average intensity change of the
5 current frame, and generates a ratio of the difference in average minimal intensity
6 values to the average intensity change of the current frame.

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8 **31.** A storage medium according to claim 30, wherein media analysis
9 agent determines that the abrupt change was due to a flashlight event if the ratio
10 does not exceed a threshold value.

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12 **32.** A storage medium according to claim 31, wherein the threshold
13 value is one (1).

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15 **33.** One or more computer-readable media having stored thereon a
16 computer program that, when executed by one or more processors, causes the one
17 or more processors to:

18 calculate a difference in light intensity histograms between two frames;
19 compare the histogram difference to a dynamically determined threshold,
20 wherein an abrupt transition is indicated if the histogram difference exceeds the
21 threshold; and
22 determine whether the abrupt transition was caused by a shot boundary
23 between the two frames or by a flashlight event.

1 **34.** One or more computer-readable media as recited in claim 33
2 wherein to determine the dynamic threshold, the one or more processors:

3 calculate an average and standard deviation value of the histogram
4 difference in a sliding window of frames;

5 generate one or more thresholds as multiples of the calculated average; and

6 determine whether the calculated standard deviation falls below a standard
7 deviation threshold before adopting the generated one or more thresholds.
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9 **35.** One or more computer-readable media as recited in claim 33
10 wherein to determine a cause of the abrupt transition, the one or more processors:

11 calculate a difference in average minimal intensity values between a
12 window of frames preceding the current frame and a window of frames subsequent
13 to the current frame;

14 generate a ratio of the average intensity change of the current frame to the
15 calculated difference in average minimal intensity values; and

16 conclude that the abrupt transition is caused by a flashlight event if the ratio
17 does not exceed a threshold.
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19 **36.** One or more computer-readable media as recited in claim 35
20 wherein the threshold is equal to one, wherein a ration that deviates from one
21 indicates that the abrupt transition is due to a shot cut, while a ratio close to one
22 indicates that the abrupt transition is due to a flashlight event.
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